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Reply

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We highly appreciate that the international discussion on our approach of material related modelling in the area of waste management is opened by the comments from S. HELLWEG and S. MÖSSNER on our publication "Waste Treatment in Product Specific Life Cycle Inventories, Part I: Incineration (Int. J. LCA 3 (1) 47-55 (1998)), Part II: Sanitary Landfill (Int. J. LCA 3 (2) 100-105 (1998))". These comments include a lot of suggestions which can be very useful for improving our process model. Nevertheless, we would like to reply on some points of criticism and misunderstanding contained in these comments.

HELLWEG and MÖSSNER criticise that no former publication on the subject of our publication is discussed or mentioned. They refer to some other approaches of material related modelling in the area of waste management and indicate the corresponding literature. The approach of the ifeu Institute was developed by ifeu in a joint project of ifeu, GVM and our Institute in 1994. The deficits of this model approach were the incentive for the development of our own incineration model. The other approaches mentioned are described by workshop proceedings and reports which are unfortunately not available for us until now. Furthermore, most of the publications mentioned by HELLWEG and MÖSSNER were published after we had finished our publication, Part I of which on "Incineration" was submitted in March 1997.

HELLWEG and MÖSSNER criticise that the further treatment of the slag from the waste incineration is not included in the model. With regard to this criticism, the goal of our approach – the material-related description of the effects of the waste incineration – has to be pointed out. Starting from this goal definition, the system boundaries for the calculation of the energy and material balance have to be defined. As shown in Figure 3 and 4, the slag is an output flow of the system studied and the treatment of the slag is located outside the system described by the model. For example, in the case of disposing the slag on a municipal landfill site, the environmental impacts resulting from the treatment of the slag could be calculated by the approach described in Part II on "Sanitary Landfill".

Furthermore, the modelling of the formation of NO_x in the furnace as exclusively depending on process parameters (temperature, air excess, etc.) is criticised. This objection is justified but it is of minor relevance if we take the system boundaries into consideration. As an output value of our process model, the concentration of NO_x in the clean gas (and not in the raw gas) is calculated, which is only process dependent, as the emissions in the clean gas after flue gas purification are assumed to be no longer depending on the input composition. This assumption has to be limited when looking at substances like HCl or SO_2. For these substances, it has to be checked whether the elements which cause their formation are contained in the fuel. If, e.g. no chlorine is contained in the specific fuel under consideration, no HCl emissions will be allocated to the incineration of this specific fuel. The allocation of slag to an ash-free input, as implied in the comments, is also impossible. The distribution of the incombustible fraction of the input to the output flows is calculated due to transfer coefficients as shown in Figure 5.

The references have to be completed by the data sources we used for comparing the transfer coefficients derived from data measured at the Wuerzburg MSWI. These data sources are included in the references [2] and [8].

With regard to the allocation of the energy produced in the waste incineration, it is suggested in the comments to compare the amount of steam produced to the amount of waste input. This approach does not answer the question which part of the steam produced can be allocated to a special waste fraction. This question is of major importance to the assessment of waste incineration in the context of product LCI and it can only be answered when the calorific value of the special waste under study is known. The calorific value has to be calculated by a theoretical approach if it is not known from experimental or literature sources. For the determination of the calorific value of solid fuels, the formula of BOIE is commonly used and the values calculated with this formula show a good correspondence to the measured values.